ENGINEERING DESIGN FILE

1. Title: Hazard Assessment Calculations for TAN-666 in Support of Re-categorization

2. Project File No.:

3. Index Codes:
   Building/Type _____ SSC ID _____ Site Area TAN

4. Summary:
TAN-666 is being re-categorized per the requirements of MCP-2451, *Safety Analysis for Other Than Nuclear Facilities*. TAN-666 is currently addressed in the TANO SAR, (INEL-94/-0163, *Safety Analysis Report for Test Area North Operations*), which is categorized as a Category 2 nuclear facility. This EDF supports re-categorizing TAN-666 as a less than Category 3 facility.

5. Review (R) and Approval (A) and Acceptance (Ac) Signatures:
   (See instructions for definitions of terms and significance of signatures.)

	R/A	Typed Name/Organization	Signature	Date
Author		R. W. Jones		3/28/03
Checker	R	I. E.Stepan		3/28/03
Independent Peer Reviewer	A			
Doc. Owner	A	K. E. Streeper	for per telecon	3/28/03
Requestor	Ac	A. G. Ramos		3/28/03
Doc. Control	Ac	Juana Cruz	Juana Cruz	3/28/03

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11. NRC related? ☐ Yes ☒ No

12. Registered Professional Engineer's Stamp (if required)

The calculations contained in Table 1 are to support the re-categorization of the TAN-666 facility to a less than Category 3 non-nuclear facility. The TAN-666 facility is currently incorporated in the TANO SAR (Reference 1), which is a Category 2 nuclear facility. Table 1 calculates the total radiological inventory based on sample results and compares the totals to the STD-1027 (Reference 2) criteria.

TAN-666 is a steel-reinforced concrete structure located west of the TAN Hot Shop, across the paved access road. The facility was designed to receive and temporarily store liquid waste generated in the TAN Hot Shop, Hot Cell, and Hot Cell Annex. The building contains a tank vault, pump vault, filter shed, and outside concrete pad. The tank vault contains two 15,000-gal storage tanks that rest horizontally, side by side, with a 5 ft high concrete wall separating them. The pump vault contains a vertical 600-gal capacity surge tank and two 200-gpm waste transfer pumps. The pumps transfer liquid waste from either storage tank or the surge tank to another storage tank, or to a transfer truck for disposal. The filter shed contains a cyclone separator and associated piping, which is used to filter out particulates from the waste to prevent clogging and to help minimize the buildup of sludge in the storage tanks. The material collected by the separator is directed to a sludge tank. The sludge tank was designed to be removed, cleaned, and replaced as required. HAD-227 (Reference 3) contains a more complete description of the TAN-666 processes.

Tank 1 in the tank vault is empty and Tank 2 (also in the tank vault) contains approximately 9,600 gal of liquid waste. Tank 3 (the surge tank located in the pump vault) contains another 200 gal of liquid. Water reportedly leaks into the tank vault as a result of snowmelt. Water is caught in the tank vault sump and subsequently transferred periodically to the surge tank. It is estimated that nearly 200 gal have been collected in a 15-year period. Samples of Tank 2 were collected in 1990 and 1994 (References 4, 5, and 6); the 1990 samples were analyzed for gamma spectroscopy and the 1994 samples were analyzed for gamma spectroscopy, strontium (Sr)-90, and tritium (H-3). The 1990 results are the most conservative and are used for this assessment. The Sr-90 and H-3 results from the 1994 sampling are combined with the 1990 results. Tank 3 was not sampled for radionuclides.

Column 1 of Table 1 lists the radionuclides analyzed during the sampling activity and Column 2 provides the highest concentration in microcuries per milliliter (μCi/mL) for each radionuclide. Column 3 provides the total volume of liquid found in tanks 2 and 3. The 9800 gallons was converted to 3.71E+07 mL [(9,800 gal) (3.79E+03 mL/gal)]. Note: The 200 gallons in the surge tank (Tank 3) was not sampled for radionuclides; therefore, for this assessment the most conservative results were used. Column 4 of Table 1 provides the total activity in μCi for each radionuclide and Column 5 converts the activity from μCi to curies (Ci). Column 6 provides the STD-1027 thresholds for a Category 3 hazard and Column 7 provides the ratio of the activity of each radionuclide with the threshold of each radionuclide. All of the radionuclides have a ratio of less than 1, which indicates the hazards are less than Category 3 levels. Also provided is the sum of the ratios (5.80E-02) that indicates the radiological hazard associated with the total inventory of liquid waste in the building is less than hazard Category 3 levels.

Table 1. Radionuclides analyzed during the sampling activity.

Radionuclides	Highest Activity (uCi/ml)	Volume (mL)	Total Activity (uCi)	Total Activity (Ci)	STD-1027 (Ci)	Ratio of STD1027/Total Act
Am-241	4.20E-04	3.71E+07	1.56E+04	1.56E-02	5.20E-01	3.00E-02
Co-60	4.00E-04	3.71E+07	1.48E+04	1.48E-02	2.60E+02	5.29E-05
Sb-125	2.10E-04	3.71E+07	7.79E+03	7.79E-03	1.20E+03	6.49E-06
Cs-134	1.60E-04	3.71E+07	5.94E+03	5.94E-03	4.20E+01	1.41E-04
Cs-137	3.00E-02	3.71E+07	1.11E+06	1.11E+00	6.00E+01	1.85E-02
Eu-154	1.10E-04	3.71E+07	4.08E+03	4.08E-03	2.00E+02	2.04E-05
Eu-155	4.30E-05	3.71E+07	1.60E+03	1.60E-03	9.40E+02	1.70E-06
Sr-90	4.00E-03	3.71E+07	1.48E+05	1.48E-01	1.60E+01	9.25E-03
H-3	5.40E-04	3.71E+07	2.00E+04	2.00E-02	1.60E+04	1.25E-06
					Total	5.80E-02

The samples collected in 1990 were also analyzed for RCRA hazardous waste characteristics and included volatile and semi-volatile organic compounds. The samples did not exhibit the characteristics of EP toxicity for metals, corrosivity, ignitability or reactivity (References 7 and 8). Several volatile organic compounds were identified in the holding tanks (Tanks 1 and 2); however, these compounds were below the regulatory limits. Several semi-volatile organic compounds were also identified. Table 2 provides an evaluation of the highest positive sample results (for all three tanks) compared to the 40 CFR 302.4 RQs.

Table 2 evaluates the chemical/hazardous material inventory from the tanks in the facility as described in Section 3. Column 1 of Table 2 lists the chemical compounds analyzed during the sampling activities and Column 2 provides the highest concentration in micrograms per liter (μg/L) for each compound. Column 3 provides the total volume of liquid found in the tanks. The 9,800 gal was converted to 3.71E+07 mL [(9,800 gal) (3.79E+03 mL/gal)]. Note: The 200 gal in the surge tank (Tank 3) was sampled for hazardous compounds and generally the same compounds were found; however, the analytical results were lower. For this assessment the most conservative results were used. Column 4 of Table 2 provides the total activity in μg for each compound and Column 5 converts the activity from μg to kilograms (kg). Column 6 provides the 40 CFR 302.4 releasable quantities (RQs) and Column 7 provides the ratio of the activity of each compound with the RQ of each compound. All of the compounds have a ratio of less than 1, which indicates the hazards below the NRASA criteria. Also provided is the sum of the ratios (2.76E-01), which indicates the overall chemical hazard associated with the total inventory of liquid waste in the tanks meets the NRASA criteria.

Table 2. Hazardous compounds inventory for TAN-666.

Analyte	Concentration (ug/L)	Volume (L)	Total (ug)	Total converted to kg	40 CFR 302.4 RQs	Ratio
Barium	2.21E+02	3.71E+04	8.20E+06	8.20E-03		
Cadmium	9.02E+01	3.71E+04	3.35E+06	3.35E-03	4.54E-01*	7.38E-03
Chromium	5.19E+01	3.71E+04	1.93E+06	1.93E-03	4.54E-01*	4.25E-03
Lead	3.08E+03	3.71E+04	1.14E+08	1.14E-01	4.54E-01*	2.51E-01
Mercury	2.91E+01	3.71E+04	1.08E+06	1.08E-03	4.54E-01*	2.38E-03
Cyanide	1.75E+01	3.71E+04	6.49E+05	6.49E-04	4.54E-01*	1.43E-03
Acetone	1.84E+02	3.71E+04	6.83E+06	6.83E-03	2.27E+03	3.01E-06
Dichlorodifluoromethane	4.68E+01	3.71E+04	1.74E+06	1.74E-03	2.27E+03	7.67E-07
Methylene Chloride	1.43E+01	3.71E+04	5.31E+05	5.31E-04	4.54E+02	1.17E-06
Xylene	1.30E+00	3.71E+04	4.82E+04	4.82E-05	4.54E+02	1.06E-07
Trichloroethene	1.07E+01	3.71E+04	3.97E+05	3.97E-04	4.54E+02	8.74E-07
1,1,1-Trichloroethane	3.29E+01	3.71E+04	1.22E+06	1.22E-03	4.54E+02	2.69E-06
Bis(2-Ethylhexyl)phthalate	1.21E+02	3.71E+04	4.49E+06	4.49E-03	4.54E-01	9.89E-03
2,4-Dimethylphenol	5.90E+00	3.71E+04	2.19E+05	2.19E-04	4.54E+01	4.82E-06
Phenol	1.87E+01	3.71E+04	6.94E+05	6.94E-04	4.54E+02	1.53E-06
					Total	2.76E-01

* - Statutory RQ used, no final RQ listed for generic or broad class.

Based on Radiological Control surveys of the TAN-666 building a contact reading of 300 mR/hr exists on the bottom of the surge tank. Microshield, Version 5 (Reference 9), was used to estimate the inventory associated with this reading. Table 3 provides the inventory estimate for each radionuclide.

Table 3. Inventory estimates from MicroShield for the contact reading on the surge tank.

Nuclide	Activity in curies
Am-241	3.32E-04
Ba-137m	2.03E-02
Co-60	2.75E-04
Cs-134	1.16E-04
Cs-137	2.15E-02
Eu-154	7.81E-05
Eu-155	3.55E-05
Sb-125	1.54E-04

The following assumptions were used to estimate the inventory:

1. The source is assumed to be ¼" thick and 24" in diameter (the cylinder volume with end shields was the geometry used in MicroShield).

2. The radionuclides found in the water samples were used for the inventory (the exception is Ba-137m, which is a daughter product of Cs-137 and is the primary gamma-emitter).

3. The activity percentage is also taken from the water sample inventory (for example, Cs-137 over 95% of the activity).

4. The bottom of the tank is 1/16" thick and is shield #1 on the MicroShield summary.

5. Contact readings are taken approximately 1" from the tank surface (airgap of 1" used in MicroShield).

6. Sr-90 and H-3 were not added to the inventory because both radionuclides are pure beta-emitters and do not contribute to the dose rate.

A copy of the MicroShield summary is attached to this EDF.

REFERENCES

1. INEL-94/0163, *Safety Analysis Report for Test Area North Operations*, Rev. 16, November 2002.

2. DOE-STD-1027-92, "Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports," U. S. Department of Energy, December 1992.

3. HAD-227, "Hazard Classification for Less Than Category 3, Low Hazard Facilities at Test Area North (TAN) – TAN-633, TAN-647, TAN-648, and TAN-666," Draft, TBD.

4. T. C. Sorenson letter Dave Harvey, "RML/Radiochemistry Analysis of TAN-666 Tank Samples, Tanks 1 &2," TCS-07-90, February 1990, March 2, 1990.

5. B. K. Schuetz letter to D. Harvey, "TAN-666 Rad. Liquid Waste Results," BKS-09-94, June 15, 1994.

6. J. A. Daley letter to M. W. Banister, "One TAN-666 Radioactive Liquid Waste Sample," JAD-19-94, May 24, 1994,.

7. Interoffice Correspondence from K. C. Wright to D. Harvey, "Data Evaluation of TAN 666 Holding Tanks Samples," KCW-14-90, May 7, 1990.

8. Interoffice Correspondence from K. C. Wright to D. R. Harvey, "Data Evaluation of TAN-666 Sump Tank Samples," KCW-24-90, June 19, 1990.

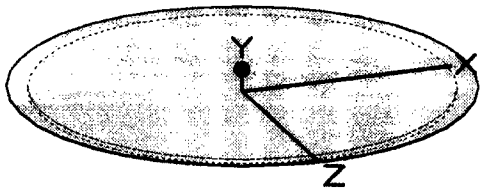
9. MicroShield, Version 5, Grove Engineering, 1998.

MicroShield v5.05 (5.05-00295)
BBWI

Page : 1
DOS File: TAN666.MS5
Run Date: February 4, 2003
Run Time: 2:40:10 PM
Duration: 00:00:01

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: TAN-666 Surge Tank
Description: Surge tank - contact reading of 300 mR/hr
Geometry: 8 - Cylinder Volume - End Shields



Source Dimensions

Height	0.635 cm	0.3 in
Radius	30.48 cm	1 ft

Dose Points

	X	Y	Z
# 1	0 cm	3.33375 cm	0 cm
	0.0 in	1.3 in	0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	1853.333 cm³	Water	1
Shield 1	.159 cm	Iron	7.86
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Included
Library : Grove

Nuclide	curies	becquerels	µCi/cm³	Bq/cm³
Am-241	3.3200e-004	1.2284e+007	1.7914e-001	6.6281e+003
Ba-137m	2.0300e-002	7.5110e+008	1.0953e+001	4.0527e+005
Co-60	2.7500e-004	1.0175e+007	1.4838e-001	5.4901e+003
Cs-134	1.1600e-004	4.2920e+006	6.2590e-002	2.3158e+003
Cs-137	2.1500e-002	7.9550e+008	1.1601e+001	4.2923e+005
Eu-154	7.8100e-005	2.8897e+006	4.2140e-002	1.5592e+003
Eu-155	3.5500e-005	1.3135e+006	1.9155e-002	7.0872e+002
Sb-125	1.5400e-004	5.6980e+006	8.3094e-002	3.0745e+003

Buildup
The material reference is : Shield 1

Integration Parameters

Radial	20
Circumferential	20
Y Direction (axial)	20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	1.365e+07	8.291e-32	7.209e-25	7.112e-33	6.183e-26
0.03	4.714e+07	1.003e-03	1.076e-03	9.944e-06	1.066e-05

Page : 2
DOS File: TAN666.MS5
Run Date: February 4, 2003
Run Time: 2:40:10 PM
Duration: 00:00:01

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.04	1.151e+07	1.802e-01	2.004e-01	7.969e-04	8.865e-04
0.05	2.268e+05	5.666e-02	6.593e-02	1.509e-04	1.756e-04
0.06	4.449e+06	4.759e+00	5.788e+00	9.453e-03	1.150e-02
0.08	4.079e+05	1.925e+00	2.527e+00	3.047e-03	3.999e-03
0.1	1.456e+06	1.457e+01	2.033e+01	2.229e-02	3.110e-02
0.15	1.430e+04	3.514e-01	5.277e-01	5.787e-04	8.689e-04
0.2	6.298e+05	2.434e+01	3.730e+01	4.296e-02	6.583e-02
0.3	2.528e+04	1.676e+00	2.521e+00	3.180e-03	4.782e-03
0.4	1.805e+06	1.707e+02	2.477e+02	3.326e-01	4.826e-01
0.5	6.588e+05	8.151e+01	1.142e+02	1.600e-01	2.242e-01
0.6	6.833e+08	1.050e+05	1.427e+05	2.049e+02	2.786e+02
0.8	5.167e+06	1.114e+03	1.446e+03	2.118e+00	2.751e+00
1.0	1.118e+07	3.127e+03	3.933e+03	5.765e+00	7.250e+00
1.5	1.143e+07	5.097e+03	6.081e+03	8.576e+00	1.023e+01
TOTALS:	7.931e+08	1.146e+05	1.546e+05	2.220e+02	2.997e+02